

Introduction

The Ecosystem Management Planning Team (EMPT) and this handbook had their origins with the 1995 publication of *Wisconsin's Biodiversity as a Management Issue* (Wisconsin DNR 1995), referred to herein as the biodiversity report. That report called for development of an ecoregion map and for planning and managing natural resources in Wisconsin. The biodiversity report further advocated for use of scientific data, landscape-scale planning, sustainability of all natural resources, and ecosystem management principles and adaptive resource management strategies upon which to base management. The EMPT was formed in 1997 as a Wisconsin Department of Natural Resources (DNR) Division of Land team to address these issues.

The EMPT is an interdisciplinary team from a broad cross section of Wisconsin DNR programs, including Forestry, Endangered Resources, Wildlife Management, Science Services, Facilities and Lands, Water Quality/Watershed Management, and DNR field staff from around the state. See Appendix A in Part 3 of the handbook ("Supporting Materials") for a list of EMPT members. Individual EMPT team members have expertise in soils, geology, glacial geology, botany, hydrology, plant ecology, forestry and forest ecology, fish and wildlife ecology, invasive species, forest diseases, natural disturbances, community ecology, ecosystem management, landscape-scale management, adaptive management, and socioeconomics.

The EMPT developed the "Ecological Landscapes of Wisconsin" map and wrote this handbook, the *Ecological Landscapes of Wisconsin*, referred to herein as "the handbook," to address the goals described above. This handbook is the culmination of 15 years of work, assessing ecological and socioeconomic resources within each ecological landscape and determining what resources are management priorities for Wisconsin and where in the state to best manage them.

What Is an Ecological Landscape?

The EMPT divided Wisconsin into 16 ecoregions, or ecological landscapes, with similar ecology and management opportunities. The ecological landscapes used in this handbook and shown on the "Ecological Landscapes of Wisconsin" map are based substantially on the National Hierarchical Framework of Ecological Units (NHFEU) (Cleland et al. 1997) and use the same boundaries as NHFEU Sections and

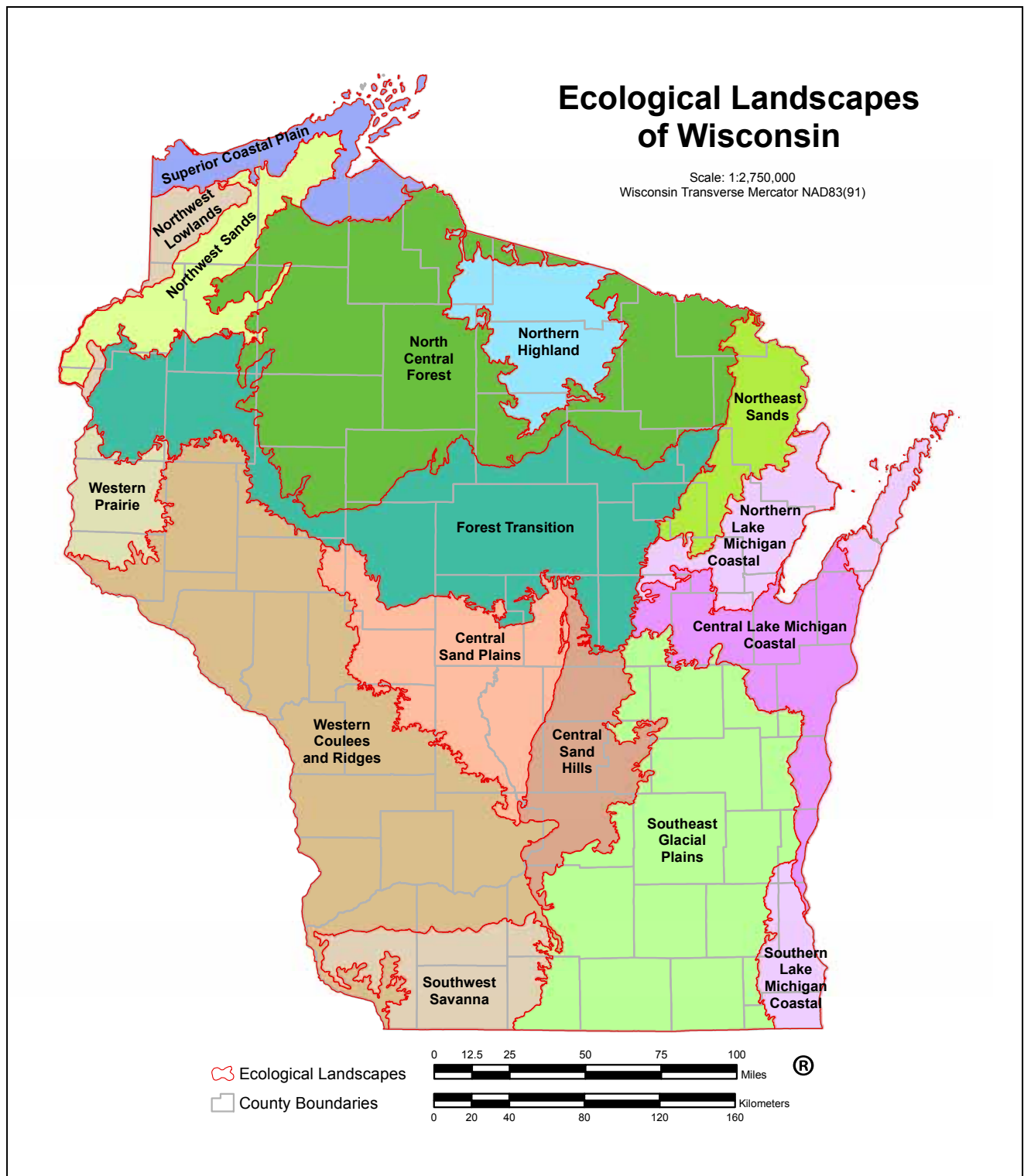
Subsections. See the NHFEU map in Appendix H, "State-wide Maps," in Part 3 of the handbook ("Supporting Materials") for more information.

The NHFEU is an ecological land classification system developed by staff of the U.S. Forest Service in cooperation with federal and state partners. A combination of physical and biological factors, such as climate, geology, topography, soils, water, and vegetation, are used to differentiate ecological units. These factors are known to control or influence biotic composition and ecological processes. Together, they provide a useful approximation of ecosystem potential.

There are three scales of the NHFEU used in this handbook: Province, Section, and Subsection. The Province boundary is based on continental climatic conditions that change in mid-Wisconsin. Climatic differences are reflected in the vegetative changes evidenced along the Tension Zone in Wisconsin. Sections are based on climatic differences within a Province and also on broadscale glacial features, especially landforms. Many Section boundaries in Wisconsin coincide with the extent of glacial ice lobes during the Wisconsin Glaciation. Different glacial lobes are associated with characteristic soil and topographic attributes. Subsections are based on associated groups of glacial landforms, including morainal systems, till plains, outwash plains, and lake plains. All of these glacial features have distinguishing soil and vegetation attributes and different combinations of natural communities. In developing the "Ecological Landscapes of Wisconsin" map, the EMPT combined some NHFEU Subsections to reduce the number of geographical units in the state to a manageable number. Therefore, the ecological landscapes are at a size (scale) between NHFEU Sections and Subsections.

Purpose of the Handbook

The goal of this handbook is to assess the ecological resources and socioeconomic conditions for the 16 ecological landscapes in the state, determine how important Wisconsin is to sustaining these resources from a regional and global perspective, and highlight ecological management opportunities best suited for these ecological landscapes. Hopefully, this publication will assist in identifying the best places in the state to manage for different natural resources from an ecological perspective (for both common and rare species and habitats) and will strive to integrate socioeconomic uses that are sustainable with the ecology of the ecological landscape.



- **Central Lake Michigan Coastal:** Lake Michigan climate influence; Great Lakes shoreline features; level to rolling topography with clay soils; large insular wetlands; Niagara Escarpment; dominant agricultural and urban land uses.
 - **Central Sand Hills:** hilly topography, sandy soils; land cover is a mix of dry oak forests, mixed pine-oak forests, agricultural fields, and wetlands; small barrens and savanna remnants; glacial end moraine with springs and coldwater streams.
 - **Central Sand Plains:** huge glacial lakebed, level topography, sandy soils, sandstone buttes; extensive dry oak, pine, aspen forests; barrens remnants; extensive acid peatlands; commercial cranberry production, agriculture based on center pivot irrigation; surrogate grasslands. Recreation and forestry are important land uses.
 - **Forest Transition:** rolling to flat topography with productive silt loam soils; historically forested, now dominated by agricultural uses (including ginseng production); extensive hemlock-hardwood forests limited to the east, pine-oak forests to the west; urban areas concentrated near the Wisconsin River.
 - **North Central Forest:** rolling topography with loamy soils; most extensive forests in Wisconsin; forested watersheds, numerous wetlands, lakes, and headwaters streams; striking bedrock features in northwest (the Penokee Range); huge public land base. Forestry and recreation are major land uses.
 - **Northeast Sands:** rolling topography with sandy soils; extensive forests are primarily oak, aspen, and pine, some hemlock-beech; large cedar swamps; coldwater streams; igneous and metamorphic bedrock outcroppings.
 - **Northern Highland:** rolling to flat glacial outwash plain, sandy or loamy soils; depressions contain many lakes and wetlands; uplands dominated by mixed hardwood-conifer forests, mostly of pine, oak, and aspen; large boggy peatlands; wild rice marshes.
 - **Northern Lake Michigan Coastal:** Lake Michigan climate influence; Great Lakes shoreline features; gently rolling to flat topography with loamy soils; mix of agriculture and hardwood/conifer forest; extensive marshes along the west shore of Green Bay; exceptional concentration of rare species and natural communities associated with the Door Peninsula, Grand Traverse Islands, and Niagara Escarpment.
 - **Northwest Lowlands:** gently rolling topography with loamy and organic soils; land cover is primarily mixed hardwood-conifer forests; large open peatlands; many headwaters streams and the corridor of the St. Croix River and associated habitats.
 - **Northwest Sands:** rolling to flat topography, sandy soils; primarily dry oak and pine forests; pine barrens, vast sedge meadow/marsh complexes; several concentrations of lakes.
 - **Southeast Glacial Plains:** rolling topography with productive silt loam soils; outstanding array of glacial landforms; agriculture is the dominant land use; numerous wetlands including large fertile marshes; the Kettle (Interlobate) Moraine is a major repository of globally rare communities such as tallgrass prairie, oak savanna, Calcareous Fen; diverse warmwater rivers and streams, and marl lakes.
 - **Southern Lake Michigan Coastal:** Lake Michigan climate influence; Great Lakes shoreline features; gently rolling topography with clay and loam soils; most populated and heavily urbanized landscape in Wisconsin; intensive agriculture.
 - **Southwest Savanna:** unglaciated ridge and valley topography; agriculture is the dominant land use; extensive grasslands include prairie and savanna remnants; patches of hardwood forest on valley side-slopes; spring-fed streams.
 - **Superior Coastal Plain:** Lake Superior climate influence; Great Lakes coastal features including freshwater estuaries, sandspits, lagoons, wave-carved sandstone cliffs, Apostle Islands archipelago; rolling to flat topography with heavy clay soils; rugged tip of the Bayfield Peninsula; mixed hardwood and spruce-fir forests; spring-fed trout streams; some agriculture, including orchards.
 - **Western Coulees and Ridges:** unglaciated ridge and valley topography; frequent outcroppings of sandstone and dolomite bedrock and associated rare communities; silts and silt loams on ridges derived from windblown loess; agriculture is the major land use on ridges and in valleys; extensive mesic and dry-mesic hardwood forests; conifer bluffs; high gradient headwaters streams. Major rivers with broad well-developed floodplains such as the Mississippi, Wisconsin, Chippewa, and Black are major repositories of diversity and the source of many social benefits.
 - **Western Prairie:** gently rolling to flat topography with many depressions forming lakes, ponds, and wetlands; silt loam soils; extensive grasslands; uplands are used primarily for agriculture; rapid urbanization; ecologically important lower St. Croix River.
- A more detailed comparison of ecological landscapes can be found in Chapter 3, "Comparison of Ecological Landscapes," and even more detail is described in the chapters for each of the 16 ecological landscapes found in Wisconsin.

The goal is to ensure that all species and habitats found in Wisconsin are sustained somewhere in the state. The handbook also suggests priorities for those resources that are most important for Wisconsin to manage to ensure their continuing sustainability across the region and continent.

This handbook is intended to assist in planning land and water management activities (including active management for product extraction, recreation, preservation, and restoration of degraded or missing natural communities) to ensure that they are compatible with the ecology of a given ecological landscape while maintaining important components of ecological diversity and ecosystem function. Therefore, this handbook is intended for broad land and water management applications. It is intended to illustrate what parts of the state may provide the most effective opportunities to sustain natural resources as landowners and managers strive to meet the needs of both people and diverse, sustainable ecosystems.

The handbook provides information that can be used in making management decisions from multiple scales, including a broader and longer-term perspective. It is not a prescription of which ecological resources should be managed in a given local area. The handbook provides the context from a statewide and global perspective on what ecological resources should receive management attention in Wisconsin and suggests the best areas in the state for them to be managed. When possible, management suggestions are made for major state properties or areas of the state that could significantly contribute to maintaining ecological resources. However, it is up to planners and managers to decide within this context exactly where these ecological resources can be managed (see the “Conservation Design” section in Chapter 1, “Principles of Ecosystem and Landscape-Scale Management,” and see Chapter 6, “Wisconsin’s Ecological Features and Opportunities for Management”). To implement the recommendations in this handbook, landscape-scale plans may need to be developed from a statewide and regional perspective by Wisconsin DNR staff along with collaborating agencies, nongovernmental organizations, and the public.

Who Will Find the Handbook Useful

The handbook may be helpful to Wisconsin DNR land and water planners, managers, and agency administrators in ensuring that, from a broad scale, the resources most in need of management get attention and that all natural resources are being sustained somewhere in the state. The handbook should be useful for local property managers as well as statewide program managers in prioritizing DNR property management activities (e.g., what natural resources to focus on a specific property) during master planning or basin planning; developing Managed Forest Law plans for private citizens;

setting forest certification goals and objectives; implementing Conservation Opportunity Areas and Wisconsin All-Bird Conservation Initiative planning; prioritizing expenditure of federal aid dollars through the Fish, Wildlife, and Habitat Management Plan and other grant sources; and for land acquisition using the *Wisconsin Land Legacy Report*.

In addition to Wisconsin DNR staff, county land and water conservation planners (e.g., Smart Growth) and regional planning commissions may use this information to develop regional land use plans in the state. Local governments (e.g., county and township land use committees) may use it for county and township land use plans. Nongovernmental organizations and land trusts may use it to develop strategic plans for preserve design and as criteria for grants and other activities. Researchers may use it to develop efficient experimental designs to test hypotheses. Educators may use it in college courses to teach students about the natural resources of the state. Private citizens may use it to understand the ecology of the place where they live and to develop a “sense of place.”

Organization of the Handbook

The handbook is divided into three parts. Part 1, “Introductory Material,” includes six introductory chapters. Chapter 1 describes the basic principles of ecosystem and landscape-scale management and how to use them in land and water management planning. Chapter 2 contains statewide assessments of seven major natural community groups in the state (northern forests, southern forests, oak savanna, oak and pine barrens, grasslands, wetlands, and aquatic communities). Chapter 3 compares the ecological and socioeconomic characteristics among the ecological landscapes in Wisconsin. Chapter 4 discusses changes and trends in Wisconsin ecosystems over time. Chapter 5 identifies major current and emerging issues. Chapter 6 identifies the most significant ecological opportunities and the best places to manage important natural resources in the state.

Part 2 of the handbook, “Ecological Landscape Analyses,” provides a detailed assessment of the ecological and socioeconomic conditions for each of the 16 individual ecological landscapes. These chapters identify important considerations when planning management actions in a given ecological landscape and suggest management opportunities that are compatible with the ecology of the landscape. Appendices, literature cited, and recommended readings that apply to specific ecological landscape chapters can be found at the end of those chapters.

Part 3 of the handbook, “Supporting Materials,” include appendices, glossary, literature cited, recommended readings, and acknowledgments that apply to the entire handbook. These appendices include a list of the Ecosystem Management Planning Team members (Appendix A), a list

of abbreviations used in the handbook (Appendix B), the data sources upon which the handbook is based (Appendix C), descriptions of ecosystem management concepts (Appendix D), a table listing opportunities for sustaining natural communities by ecological landscape (Appendix E), an annotated list of some important natural resource plans and assessments (Appendix F), descriptions of natural communities, aquatic features, and selected habitats (Appendix G), statewide maps useful for comparing natural resources at a statewide scale, including vegetation prior to Euro-American settlement, current land cover, public lands, soils, geological data, climate data, and hydrology (Appendix H), and a table showing forest types that were combined into forest type groups for Forest Inventory and Analysis data (Appendix I).

For all species, the scientific name is listed in italics and in parentheses after the first occurrence of the common name in the main body of text in each chapter. After that, only the common name is used. Each chapter includes a table of all common and scientific names of species referred to in that chapter.

Naming Conventions

For both the scientific and common names for birds, we used the American Ornithologists Union Checklist of North America Birds. For other animals, we used the Wisconsin DNR's Natural Heritage Working List for both scientific and common names. For more common mammals that do not occur on the Working List, we used Wisconsin DNR Miscellaneous Publication PUB-SS-1089 2011, "Current Scientific and Standard Common Names of Wisconsin Mammals." For plants, we used the Wisconsin State Herbarium Wisconsin checklist of the vascular plants of Wisconsin for both scientific and common names. The use of capitalization for common names comes from those particular sources. Taxonomies for species and/or taxonomic groups are occasionally updated, causing changes to the scientific name of a species. In this handbook, we used the taxonomies and scientific names that were current in 2009. More recent taxonomies and scientific names can be found at the sources listed above. Throughout this document, recognized natural community names that appear on the DNR's Natural Heritage Working List are capitalized. Occasionally, these communities are referred to generically, and in those cases, the names are not capitalized (e.g., the use of the "Northern Sedge Meadow" natural community is capitalized but when referring generally to "sedge meadows," it is not).

Where to Find the Handbook

The Wisconsin DNR's *Ecological Landscapes of Wisconsin* handbook is available online, in CD format, and in limited quantities as a hard copy. Individual chapters are available for download in PDF format through the Ecological Landscapes of Wisconsin website (<http://dnr.wi.gov/topic/landscapes/>). The introductory chapters (Part 1) and supporting materials (Part 3) should be downloaded along with individual ecological landscape chapters to aid in understanding and using the ecological landscape chapters. The website also contains select parts of the handbook, highlighting key sections of each ecological landscape chapter such as the "Ecological Landscape at a Glance," "General Description and Overview," "Significant Flora," "Significant Fauna," and "Management Opportunities." Each excerpt links to the relevant sections in the full chapters.

Numerous maps referenced throughout the handbook are also available through the website along with links to additional information. These web pages are meant to be dynamic and were designed to work in close association with materials from the Wildlife Action Plan as well as information on Wisconsin's natural communities from the Wisconsin Natural Heritage Inventory Program.

If you have a need for a CD or paper copy of this handbook, you may request one from Dreux Watermolen, Wisconsin Department of Natural Resources, P.O. Box 7921, Madison, WI 53707.

Suggested Citation for the Handbook

Wisconsin Department of Natural Resources. 2012. *Ecological landscapes of Wisconsin*. Handbook 1805.1, Wisconsin Department of Natural Resources, Madison.

Literature Cited

- Cleland, D.T., P.E. Avers, W.H. McNab, M.E. Jensen, R.G. Bailey, T. King, and W.E. Russell. 1997. National hierarchical framework of ecological units. Pages 181–200 in M.S. Boyce and A. Haney, editors. 1997. *Ecosystem management: applications for sustainable forest and wildlife resources*. Yale University Press, New Haven, Connecticut.
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